655

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JOB OPPORTUNITIES IN SANITARY ENGINEERING

by Harvey F. Ludwig, M. ASCE

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JOB OPPORTUNITIES IN SANITARY ENGINEERING

Harvey F. Ludwig,[1] M. ASCE

What the Job is and Does:

The attached definition of the sanitary engineer, as approved December 14, 1954 by the National Research Council—Committee on Sanitary Engineering and Environment, is a good description of the functional or technical role of the sanitary engineer. It describes the kind of work he does and the relationship of this to community life and interests. In a few words, the sanitary engineer's interests may be classified in four broad phases of environment—the air, water, food, and shelter. His aim is to control these aspects of environment in the interest of the public health—to eliminate injurious effects that can be feasibly eliminated, and to control those which must be tolerated to reduce the injurious effects to a minimum, and to promote environmental changes which contribute positively to good health and well-being. The sanitary engineer, since he makes it easier for people to keep healthy and to pay less attention to the actual business of keeping alive, makes it possible for them to advance their pursuits with greater effectiveness.

The Sanitary engineering profession is essentially a product of the 20th century—of the impact of modern technology on the community environment. In 1900 the national economy was largely rural—the population was relatively small, at 75 million, and two-thirds lived on farms. By 1950, the population had doubled to 150 million, and industrial production was up 700 per cent, half of this since 1940. It is anticipated by 1975 industry will at least again double, with a supporting population of 200 million. Since sanitary engineering problems are intimately associated with modern community development, it can be said that the profession of sanitary engineering is approaching full realization and that the opportunities before the sanitary engineer of the future will be increasingly challenging. The sanitary engineer who shows the competence and leadership plays a key role in modern community development in social, economical, and political as well as its technical aspects.

Why it is Interesting and Important:

The work of the sanitary engineer is important because it is dedicated to promoting and protecting the public health and welfare, especially because it must secure this objective within the economic limitations of the community. It is interesting because, more so than in any other field of engineering, the sanitary engineer must relate his technical skills to economical, social, and political factors in order to achieve the desired results; moreover, his technical interests perhaps cover a broader area than in any other engineering field, combining engineering skills with knowledge in biology, chemistry, physics, and medicine.

1. Chf., Eng. Resources Program, Public Health Service, U. S. Dept. of Health, Education, and Welfare, Washington 25, D. C.

Who is Likely to Make Good in it:

The sanitary engineering profession requires engineers who can combine keen technological interests with an appreciation of the social, economic, and political factors making up the over-all community complex. Sanitary engineering has sometimes been called "human engineering," "environmental engineering," etc., to indicate its concern with the total environment and its broad relationship to health and well being.

How to get Started:

Initial requirement is a degree in engineering, usually in civil engineering and sometimes in chemical, mechanical, or other branches. In most colleges and universities offering formal curricula in sanitary engineering, these curricula are organized as components within civil engineering.

Where This Kind of Work Fits Into the Engineering Picture:

All sanitary engineers are concerned with works and programs affecting man's health, but only about a third of the profession is employed by official public health agencies. The primary protection of public health depends upon certain community public works (e.g., the water supply, sewerage system, etc.) or community programs (e.g., refuse collection and disposal) which are not operated by the official health agencies but over which the health agencies maintain surveillance. The public health agencies supplement these by certain direct operations, especially in the sanitary inspection field, e.g., inspection of milk and food establishments, of individual household sewage disposal systems, of housing, etc. Direct sanitary engineering operations conducted by public health agencies are today broadening to include complex new programs such as programs for control of radiation exposure resulting from widespread peace-time application of nuclear energy.

Another important area of health work in which sanitary engineers play an important role is conducted by industry - protecting the health of the individual at his work place. This is the field known as industrial hygiene, or occupational health.

Pros and Cons:

Sanitary engineering is certainly one of the most challenging of all fields of engineering, requiring as it does the application of a broad combination of technical and humanistic knowledges and skills. The newer evolving fields of sanitary engineering, e.g., radiological health engineering, air pollution control engineering, and water pollution control engineering, are presenting perhaps the most complex problems ever faced in the development of the modern metropolitan community. Air pollution control problems, for example, will require, for their efficient and equitable solution, the application of the best available skills in the fields of physics, chemistry, meteorology, biology, medicine, etc., plus applied economics to develop solutions which permit the continuing advance of modern technology without permanent impairment of our air resources. Again, in radiological health, the degree to which injurious radiations can be controlled, whether from nuclear processes or from wastes from these processes, will be a governing factor in the rate at which nuclear energy can be applied for peacetime uses and benefits.

Sanitary engineering career opportunities are available in the Federal, State, and community governments, in industry and commerce, in consulting

engineering practice, and in research and teaching—a variety sufficient to suit almost any engineer's particular personal interest.

As to the "cons," it should be noted that the sanitary engineering profession is still in the transitional process of evolution (as described further in the following section), and hence is not as well-organized as some of the older engineering professions. For example, educational standards are not uniform in the colleges and universities throughout the country. Also, the sanitary engineer's professional interests are distributed among a considerable number of professional and technical societies, requiring that he belong to an extraordinary number of these to keep abreast of his field. And, as previously mentioned, the field is more complex than most engineering fields, and hence more exacting.

With respect to salaries, sanitary engineers compare favorably with other engineers working for similar employers. For example, a sanitary engineering consulting practice is generally as profitable as a structural engineering practice, and the sanitary engineer in government earns about the same as other engineers in government. Working conditions are generally favorable because sanitary engineers are primarily concerned with community development and hence generally live in cities or metropolitan areas. In fact, the larger the area the more complex its sanitary engineering problems -e.g., the smog problem at Los Angeles.

Look to the Future:

Reaction from the impact of modern technology is possibly more profound in sanitary engineering than in any other branch of the engineering profession, and more than for any other professional group working in public health. Sanitary engineering as a science had its start back in the 1890's in working with the water phase of the environment; i.e., water supply and sewerage. Water represents such an important influence in the environment that it was natural for the founders of the sanitary engineering profession to give it clear priority in their approach to the total environment. The inclusiveness of the term "total environment" is only now beginning to be realized. The mushrooming chemical industry, the growing application of atomic energy, the revolutionary changes in food processing, and many more recent technological developments are affecting in multitudinous ways the environmental exposures of man. In fact, it appears that the extent to which health hazards in the environment are kept under control is likely to be the governing factor in the rate of advancement of total technology.

The evolution of sanitary engineering problems can be considered as falling into three echelons.[2] The first echelon is concerned primarily with enteric disease control. This means concentration of effort to keep human excreta out of the diet, e. g., in the treatment of water supplies, safe handling of sewage, and protection of food. Control of insects and rodents, where they are of public health importance, also should be included in this classification. This is the area of work critically needed in many countries abroad, to permit them to develop and assume greater responsibilities in the world situation. Engineers interested in work in foreign countries can certainly look forward to ample opportunities in sanitary engineering.

The second echelon in sanitary engineering evolution is concerned with advanced water treatment technology, with advanced sewage treatment tech-

2. Hollis, M. D. The Sanitary Engineer and Environmental Health. The Military Surgeon, 115, 51-54 (July , 1954).

nology, including reclamation of valuable organic components, with industrial waste treatment, and with revolutionary changes in food processing to provide "built-in" protection against contamination. Another important area is industrial hygiene - control of environment in the work place to protect the worker. Also involved is the field of shelter - the hygiene of housing, including the broadening of insect and rodent control concepts to take into account physical comfort and aesthetic considerations. Characteristic of this echelon is recognition of the significance of economics as a basic factor in the design and development of sanitary engineering facilities.

The third echelon is in transition, and represents a major mutation in sanitary engineering practice. A big factor in this stage is an appreciation of a rate of technological change unprecedented in histroy. An example is the "chemical environment," resulting from industrial expansion, especially the mushroom growth of synthetic chemical production and use. Chemical production today is 300 per cent greater than just prior to World War II. The widespread use of chemicals in production and processing of foods, the increasing use of artificial fibers for clothing,construction, and innumerable household items, together with contamination of the air and water by chemical wastes, is a complex situation involving possible hazards as yet unknown or evalauted. Life in a synthetic environment appears to be an increasing reality.

The emerging atomic age is compounding the situation. For sanitary engineering, it means an additional set of units, formulas, and equations. The development and use of nuclear energy for power and other purposes bring with it public exposure to radiations and contamination from radioactive wastes. If precedent is followed, it is unlikely that the rate of expansion in the application of atomic energy will await conventional solutions of these health problems any more than the development of automobile travel awaits solution of the problem of traffic accidents. The challenge is to devise protective measures in advance of the inevitable.

Health problems of the atmosphere - air pollution control - represent a target area just beginning to be studied. Progress of sanitary engineering in this field compares with the status of water pollution control about 1925. The same sort of job has to be faced, but it is technically much more difficult. A better understanding is needed of both natural and man-made pollutants, and their effects under various weather conditions. The events at such places as Donora, London, and Los Angeles merely highlight what is shaping up as a generalized situation. Here again the rapidity with which the problem is developing likely will require application of controls ahead of guiding research. At best the two will move in parallel.

A characteristic feature of the third-echelon stage of development is the need for close coordination of the sanitary engineering or health interests in any particular phase of environment with all other significant economic needs. For example, the provision of an ample and a safe municipal water supply is becoming no longer a water problem to itself but part and parcel of total water resource development plans for entire regions. In more and more areas demands for water, to meet the needs of increasing population and industry in growing urban centers, have reached or are reaching the limits of readily available supplies and hence have become competitive with water needs for irrigation, power, and other necessary uses in the region. Conservation of water in the region will become an increasing necessity. This means increased treatment of sewage and industrial wastes being discharged to streams - to preserve stream quality to permit repeated reuse of water as the streams

flow from city to city and from industry to industry, and also to maintain a desirable environment for fish and wildlife.

To solve these new environmental health problems requires not only competence in engineering but also a clear understanding of such other disciplines as chemistry, biology, and physics. The sanitary engineer today must apply a composite of basic scientific knowledges to an unprecedented degree. Much of this basic knowledge must be continually developed through increasing research. It is believed that in sanitary engineering, the gap between what is known and what must be discovered is becoming greater and greater. The engineering research center of the Public Health Service at Cincinnati is devoting its modest resources to this effort. However, the total amount of research now conducted in sanitary engineering, including that of the Armed Services and the Universities, is far short of the needs. Producing what is required remains a major problem and will provide many opportunities for sanitary engineers interested in research.

In summary, the sanitary engineer entering the profession today has before him a comprehensive range of opportunities requiring all levels of academic training. The bachelor's or master's degree is generally required for most positions. For those interested in the research aspects, the doctorate degree is recommended.

Standards and Status:

For most effective operation sanitary engineers, like other professional engineers, should be registered or licensed within the registration laws of the States. They also need to participate actively in the professional and technical societies concerned. The American Society of Civil Engineers, through its Sanitary Engineering Division, is interested in the professional and technical aspects of all phases of sanitary engineering. Association with this organization should be supplemented by membership in appropriate technical societies. Most sanitary engineers working in water supply and waste disposal, for example, are active in the American Water Works Association and the Federation of Sewage and Industrial Wastes Association, and many also belong to the American Public Health Association. Another example, sanitary engineers working the field of industrial hygiene may wish to belong to the American Industrial Hygiene Association or the American Conference of Governmental Industrial Hygienists, or both, in addition to organizations having more inclusive interests as noted above.

Within the past few years action has been taken toward establishment of a national board of certification. The board would be similar to boards now employed by physicians and dentists to designate those who have achieved acknowledged ability in segments of their professions. The proposed board would be the first specialty engineering certification program undertaken in this country. The certification program will be administered by an Inter-Society Sanitary Engineering Board operating in collaboration with the American Society of Civil Engineers and the Engineers Joint Council.

Another recent development of significance is the potential destructiveness of atomic, biological, and other special weapons. Appraisals by various national authorities are pointing up the importance to public health of sanitary engineering activities in event of atomic attack. Disruption of essential community facilities—water works, sewerage systems, food services, and shelter—possibly combined with contamination of the atmosphere, could result in overwhelming demands for emergency sanitary engineering specialists to make it possible for the blast survivors to keep on living. Sanitary engineers

must be organized in advance if prompt mobilization, and deployment, wherever needed, are to be accomplished. The commissioned reserve organizations of the military services, together with that of the U. S. Public Health Service, represent collectively an almost ideal mechanism for doing this job. The flexibilities of the reserve mechanisms, including inter-service details, permit prompt and total utilization of the nation's sanitary engineer resources. The commissioned engineer reserve of the Public Health Service is now being expanded and strengthened in preparation for possible war emergency. It is anticipated that this component would be primarily responsible for assisting States and communities on civil defense sanitary engineering problems.

For More Information:

A recommended source of additional information is the Division of Sanitary Engineering, American Society of Civil Engineers. Address inquiries to the Executive Secretary, Division of Sanitary Engineering, American Society of Civil Engineers, 33 West 39th St., New York City.

Within the Federal govenment, further information is available from the Chief Engineer, Public Health Service, Department of Health, Education and Welfare, Washington 25, D. C. With State governments, information may be obtained from the chief engineers in the State Departments of Health.

APPENDIX

Subcommittee on Personnel and Training
of the
Committee on Sanitary Engineering and Environment
National Research Council
Preliminary Draft
of
Definition of the Term
"Sanitary Engineer"
Approved—December 14, 1954

The professional occupational title "Sanitary Engineer" shall apply to a graduate of a full 4-year, or longer, course leading to a Bachelor's, or higher, degree[1] at an educational institution of recognized standing[2] with major study in engineering, who has fitted himself by suitable specialized training, study, and experience (a) to conceive, design, appraise, direct, and manage engineering works and projects developed, as a whole, or in part, for the protection and promotion of the public health, particularly as it relates to the improvement of man's environment, and (b) to investigate and correct engineering works and other projects that are capable of injury to the public health by being or becoming faulty in conception, design, direction or management.

The practice of sanitary engineering includes the following activities:

a) Surveys, reports, designs, reviews, direction, management, operation and investigation of works or programs for:
   1) Water supply, treatment, and distribution.
   2) The collection, treatment, and disposal of community wastes, viz. sanitary sewage, industrial wastes and refuse including salvage and reclamation of useful components of such wastes.
   3) The control of pollution of surface waterways and ground waters, and of surface and subsurface soils.
   4) Milk and food sanitation.
   5) Housing and institutional sanitation.
   6) Insect and vermin control or eradication.

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1. Persons lacking in formal education but who otherwise meet the terms of the above definition may be considered as having the equivalent of a full four-year course in engineering in an educational institution of recognized standing provided they are registered engineers and have sufficient experience or training of the type defined above to substitute for the engineering education lacking. The basis of such substitution shall be two years of appropriate training or experience equivalent to one year of formal engineering education.
2. An educational institution of recognized standing is defined as one which is accredited by a national or regional accrediting association such as the Association of American Universities, or the New England, Middle States, North Central, Southern, or Northwest Association of Secondary and Higher Schools, or one whose professional curriculum has been accredited by the Engineers' Council for Professional Development or the Committee on Professional Education, American Public Health Association.

7) Rural, camp and recreation place sanitation.
8) The control of atmospheric pollution and air quality; light, noise, vibration and toxic materials, including application to work spaces in industrial establishments (industrial hygiene engineering).
9) The prevention of radiation exposure.
10) Other fields that have as their major objective the control of environmental factors affecting health.

b) Professional research and development work supporting the activities listed in a).

c) Responsible teaching of sanitary engineering subjects in educational institutions of recognized standing.

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VOLUME 80 (1954)

MARCH: 414(WW)[d], 415(SU)[d], 416(SM)[d], 417(SM)[d], 418(AT)[d] 419(SA)[d], 420(SA)[d], 421(AT)[d], 422(SA)[d], 423(CP)[d], 424(AT)[d], 425(SM)[d], 426(IR)[d], 427(WW)[d].

APRIL: 428(HY)[c], 429(EM)[c], 430(ST), 431(HY), 432(HY), 433(HY), 434(ST).

MAY: 435(SM), 436(CP)[c], 437(HY)[c], 438(HY), 439(HY), 440(ST), 441(ST), 442(SA), 443(SA).

JUNE: 444(SM)[e], 445(SM)[e], 446(ST)[e], 447(ST)[e], 448(ST)[e], 449(ST)[e], 450(ST)[e], 451(ST)[e], 452(SA)[e], 453(SA)[e], 454(SA)[e], 455(SA)[e], 456(SM)[e].

JULY: 457(AT), 458(AT), 459(AT)[c], 460(IR), 461(IR), 462(IR), 463(IR)[c], 464(PO), 465(PO)[c].

AUGUST: 466(HY), 467(HY), 468(ST), 469(ST), 470(ST), 471(SA), 472(SA), 473(SA), 474(SA), 475(SM), 476(SM), 477(SM), 478(SM)[c], 479(HY)[c], 480(ST)[c], 481(SA)[c], 482(HY), 483(HY).

SEPTEMBER: 484(ST), 485(ST), 486(ST), 487(CP)[c], 488(ST)[c], 489(HY), 490(HY), 491(HY)[c], 492(SA), 493(SA), 494(SA), 495(SA), 496(SA), 497(SA), 498(SA), 499(HW), 500(HW), 501(HW)[c], 502(WW), 503(WW), 504(WW)[c], 505(CO), 506(CO)[c], 507(CP), 508(CP), 509(CP), 510(CP), 511(CP).

OCTOBER: 512(SM), 513(SM), 514(SM), 515(SM), 516(SM), 517(PO), 518(SM)[c], 519(IR), 520(IR), 521(IR), 522(IR)[c], 523(AT)[c], 524(SU), 525(SU)[c], 526(EM), 527(EM), 528(EM), 529(EM), 530(EM)[c], 531(EM), 532(EM)[c], 533(PO).

NOVEMBER: 534(HY), 535(HY), 536(HY), 537(HY), 538(HY)[c], 539(ST), 540(ST), 541(ST), 542(ST), 543(ST), 544(ST), 545(SA), 546(SA), 547(SA), 548(SM), 549(SM), 550(SM), 551(SM), 552(SA), 553(SM)[c], 554(SA), 555(SA), 556(SA), 557(SA).

DECEMBER: 558(ST), 559(ST), 560(ST), 561(ST), 562(ST), 563(ST)[c], 564(HY), 565(HY), 566(HY), 567(HY), 568(HY)[c], 569(SM), 570(SM), 571(SM), 572(SM)[c], 573(SM)[c], 574(SU), 575(SU), 576(SU), 577(SU), 578(HY), 579(ST), 580(SU), 581(SU), 582(Index).

VOLUME 81 (1955)

JANUARY: 583(ST), 584(ST), 585(ST), 586(ST), 587(ST), 588(ST), 589(ST)[c], 590(SA), 591(SA), 592(SA), 593(SA), 594(SA), 595(SA)[c], 596(HW), 597(HW), 598(HW)[c], 599(CP), 600(CP), 601(CP), 602(CP), 603(CP), 604(EM), 605(EM), 606(EM)[c], 607(EM).

FEBRUARY: 608(WW), 609(WW), 610(WW), 611(WW), 612(WW), 613(WW), 614(WW), 615(WW), 616(WW), 617(IR), 618(IR), 619(IR), 620(IR), 621(IR)[c], 622(IR), 623(IR), 624(HY)[c], 625(HY), 626(HY), 627(HY), 628(HY), 629(HY), 630(HY), 631(HY), 632(CO), 633(CO).

MARCH: 634(PO), 635(PO), 636(PO), 637(PO), 638(PO), 639(PO), 640(PO), 641(PO)[c], 642(SA), 643(SA), 644(SA), 645(SA), 646(SA), 647(SA)[c], 648(ST), 649(ST), 650(ST), 651(ST), 652(ST), 653(ST), 654(ST)[c], 655(SA), 656(SM)[c], 657(SM)[c], 658(SM)[c].

c. Discussion of several papers, grouped by Divisions.
d. Presented at the Atlanta (Ga.) Convention of the Society in February, 1954.
e. Presented at the Atlantic City (N.J.) Convention in June, 1954.

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